EDUCATION CORNER

From the Eastern Vascular Society

Time for radiation safety program guidelines for pregnant trainees and vascular surgeons

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Objectives: **The evolution of endovascular surgery has increased the vascular surgeon's exposure to radiation, raising concern for female vascular trainees and staff of childbearing years. We developed surveys for female trainees, established vascular surgeons, and program directors in vascular surgery to determine current practices with respect to pregnancy and radiation exposure guidelines.**

Methods: **Two surveys were conducted to evaluate radiation exposure during pregnancy. A survey of the members of the Association of Program Directors in Vascular Surgery was conducted in an attempt to gather information about existing program and institutional radiation policies and assess the need for standard guidelines. A second survey was given to women in vascular surgery in an effort to obtain opinions among concerned groups regarding establishment of a policy from women who were exposed to radiation during and after completion of vascular training.**

Results: **Fifty-three of 181 female vascular surgeons (29% response rate) responded to the survey, with the majority (53% [28/53]) pregnant during training or practice. Though 68% of trainees and 82% of faculty performed endovascular procedures during pregnancy, only 42% of trainees and 50% of faculty wore a fetal badge. One trainee (3.7%) had complications during pregnancy that necessitated cessation of fluoroscopic procedures or limiting call. There were four practicing surgeons who had complications during their pregnancy. Of these, one was hospitalized with fetal decelerations secondary to excessive on-call obligations with double leading and heavy endovascular call coverage. The majority of women (>60%) felt supported by the program and that they were treated fairly. Over 90% of female trainees and faculty felt that establishment of guidelines for radiation safety for all vascular surgeons would be beneficial. Many (77%) felt that a policy would aid in the recruitment of talented women into the field. Thirty-two of 99 Association of Program Directors in Vascular Surgery program directors responded to the survey. Of the 32 program directors that responded (32% response rate), 75% would allow the pregnant trainee flexibility in rotation schedule. Finally, 75% of program directors support development of a national policy, and 81% would incorporate one into their program.**

Conclusions: **There is compelling interest to establish radiation safety guidelines for the pregnant trainee or vascular surgeon. Consideration should be given at the Society leadership level to develop and support radiation safety guidelines for all vascular surgeons. (J Vasc Surg 2012;55:862-8.)**

The evolution of endovascular surgery has increased the vascular surgeon's exposure to radiation, raising concern for female vascular trainees and staff of childbearing years. Consideration is already given to all patients, including pregnant women, who may need medical x-rays with guidelines in place to minimize risk to patient and fetus.[1] Currently women account for at least half of the medical school graduates and are represented in all postgraduate medical education training programs.[2,3] Vascular societies recognize the need to increase the number of female vascular residents and fellows.[3,4] This, along with a need to get more vascular surgeons out into the workforce, helped propel the development of a new paradigm of training in vascular surgery, the integrated 5-year vascular residency

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program. The new pathway has been adopted by many training institutions and welcomed enthusiastically by medical students.

Endovascular procedures requiring prolonged exposure to radiation comprise more than 50% to 75% of all vascular procedures performed in current academic or private practices.[5,6,7] This means that integrated vascular residents are expected to get regularly exposed to radiation not only for 2 years but rather for 5 years during endovascular procedures in their training. The newer training paradigm affects the time frame of radiation exposure, which may occur over a longer period of time during a woman's peak childbearing years but would not necessarily affect that woman's lifelong radiation exposure. This may have implications for female trainees contemplating pregnancy during these years.[8] In a recent survey among female medical students, 31% expressed concerns regarding exposure to radiation that might affect their health and their childbearing potential.[2] This percentage will probably be higher among vascular residents and fellows participating daily in long endovascular procedures. Women in practice may have more autonomy to change their schedules to minimize fluoroscopic exposure during pregnancy; however, this is variable and depends upon the type of practice and number of partners in that practice. Many women may not feel a level of control, as their childbearing years in practice are usually while they are the more junior partners. They may feel pressure to produce and maintain their on-call schedule obligations and total volume of cases.

Lack of standardized policies to protect all vascular surgeons, especially pregnant female residents and surgeons, at least during the crucial weeks of gestation, and written information regarding pregnancy and radiation may dampen the initial enthusiasm of qualified women considering a vascular residency.

We developed a survey for female trainees, established female vascular surgeons, and all program directors in vascular surgery to determine current practices with respect to pregnancy and radiation exposure guidelines.

METHODS

Two surveys were conducted to evaluate radiation exposure during pregnancy. The first survey was distributed to the members of the Association of Program Directors in Vascular Surgery (APDVS) in an attempt to gather information about existing program and institutional radiation policies as well as assess the need for standard guidelines. The survey consisted of 11 questions regarding the existence of guidelines for vascular trainees, other female vascular surgeons, other workers working with radiation, the availability of counseling by a medical physicist, availability of written policies, limits, or restrictions placed on fluoroscopy exposure for pregnant trainees, access to additional means of radiology reduction, and monitoring. Questions were also asked as to whether or not the program director would permit a change in rotation schedule to minimize radiation exposure and incorporate a national standard policy or set of guidelines into their program.

A second survey was given to women in vascular surgery in an effort to obtain an opinion regarding establishment of a policy from women who were exposed to radiation during and after completion of vascular training. Inquiries were made regarding pregnancy during training or in practice, performance of endovascular procedures while pregnant, degree of or sense of support by the program and institution in monitoring the fluoroscopic exposure, use of a fetal badge, and/or counseling by a physicist. Questions were asked and comments encouraged regarding any complications during the pregnancy that caused alteration of the daily routine as an endovascular specialist and accommodations made by the program to allow performance to the best of one's ability without putting stress on the fetus. Furthermore, female trainee and surgeon opinions were solicited regarding established guidelines for pregnant trainees or attending physicians in vascular surgery, the impact this would have on the recruitment of talented women into the field, and how a policy accepted and supported by the leadership of the Society of Vascular Surgery would positively affect this concept.

These questions were derived from several sources, including the survey conducted by Blake et al and the American Association for Women Radiologists and the Association of Program Directors in Radiology[9] and through the collaborative work of the Women in Vascular Surgery and their resultant *Journal of Vascular Surgery* supplement publication regarding radiation safety and vascular surgery. Additionally, comments and concerns of women in vascular surgery who were pregnant, have been pregnant, or are planning to become pregnant at the time of the creation of the survey were used to develop the questions. It was apparent through these discussions that each program had their own way of informing and regulating radiation exposure during and after training.

Each survey was sent through the Internet using Survey Monkey.

Statistical analysis. The response rate of those agreeing and disagreeing was recorded as well as responses to each survey and comments from the responders of both. A method of proportions was applied to derive a proportion of those agreeing, disagreeing, and non-responders.

RESULTS

Survey 1. Thirty-two of 99 APDVS program directors (32%) responded to the survey. Questions and responses are included in Appendix I (online only). Only 28.1% (9/32) reported that there was a written policy or set of guidelines for pregnant residents and fellows exposed to radiation at their institution, and 40.6% (13/32) have a policy applicable to pregnant faculty or technologists. Twenty-eight percent (9/32) responded that residents/fellows had expressed concern about radiation exposure, and 71.9% (23/32) had counseling available regarding radiation exposure to the fetus. Twenty-five percent (8/32) had restrictions placed on fluoroscopy and/or interventional work for their pregnant vascular surgery trainees. Additional means of radiation reduction (ie, double-lead

Table I. Sample of survey comments from practicing female vascular surgeons

'I had absolutely no support from radiation safety. In addition, there is very little information out there regarding proper protection and risks for pregnant vascular surgeons. I took no extra precautions for either pregnancy and performed procedures up until my delivery date both times. This is a new issue for vascular specialists, as it was not a risk for the prior generation of vascular surgeons'
'I frequently worry that residents are getting more exposure than faculty by using old damaged community Operating Room lead'
'I didn't feel comfortable over 18 years ago telling my program that I was pregnant. I just used extra lead and tried to keep a distance. Now our fellows are much more supported by the program'
'Where I did General Surgery training, vascular attendings were great about supporting me when I was pregnant during my chief year. When I did Vascular Fellowship, all attendings were extremely supportive about radiation safety and allowed me to continue to practice if safety measures were taken for baby and myself. A great experience.'
'I was pregnant my research year, but took call once a month. I requested not to do any endovascular cases and that was fully supported by my faculty and colleagues.'
'There were no complications that caused me to change my routine, but I did alter it (ie, limit number of endovascular cases, use of extra lead). My fellowship program was very supportive during my pregnancy. I was pregnant during the last 6 months of my fellowship. I did not notify my program until I was 5 months pregnant.'
'I did not receive individual counseling; rather I had to read some material prior to being assigned a fetal badge. To obtain a fetal badge, I had to inform my program director, which I felt was unfair. I did not intend to tell him until after my first trimester had passed. My program stated that they supported me, but I was not allowed to limit my cases. For example, I wanted to avoid cases that were purely diagnostic such as preoperative angiograms where no intervention was anticipated. Some staff was fine with it, others were not.'
'I was very lucky and supported. I was a second year fellow and the second half of the year I was pregnant. Second year is our "open" year, first year is our "endo" year, so I wasn't expected to do many endovascular cases, but there were some to be done. I did a few cases, wore double lead and as soon as I revealed my pregnancy to the faculty they told me not to do any endovascular cases unless I really wanted to. They never pressured me to do an endovascular case, although I did pressure myself a few times when things were really busy and I knew it would really help.'
'We were never counseled at any point about radiation during our fellowship and did not have badges. When I approached the physicists, they were shocked. I got a badge, which I wore sometimes. I also wore two pieces of lead.'

aprons, pregnancy lead) and additional means of monitoring (ie, extra dosimeter badges or fetal badge) were reported to be available in 71.9% (23/32) and 68.8% (22/32), respectively. Seventy-five percent (24/32) would allow the pregnant trainee flexibility in rotation schedule. Finally, 75% (24/32) of program directors support development of a national policy or set of guidelines, and 81.3% (26/32) would incorporate guidelines, either part or in whole, into their program.

Survey 2. Fifty-three of 181 female vascular surgeons (29% response rate) responded to the survey, with the majority (53% [28/53]) pregnant during training or practice. Questions and responses are included in Appendix II (online only). Although 68% of trainees performed endovascular procedures during pregnancy, only 42% of trainees wore a fetal badge. Eight of 18 responders (44.4%) had counseling by a physicist regarding fluoroscopic exposure. One trainee (3.7%) had complications during pregnancy that necessitated cessation of fluoroscopic procedures or limiting call. She was not performing fluoroscopic procedures at the time of the complication. Four practicing surgeons reported complications. One of these surgeons had been hospitalized after an arduous weekend on-call performing interventional procedures. The majority of trainees (63.2% [12/19]) felt supported by the program, and 68.4% (13/19) felt as if they were treated fairly. Over half (52.6% [10/19]) responded that accommodations were made to allow performance to the best of one's ability without putting excessive stress on the pregnancy/fetus.

Over 90% (48/53) of female trainees and faculty felt that establishment of guidelines for radiation safety for all vascular surgeons would be beneficial. Many (77.4% [41/53]) felt that a policy would aid in the recruitment of talented women into the field, and 90.6% (48/53) feel that such a policy that is accepted and supported by the leadership of the Society for Vascular Surgery would be encouraging to those women who are pregnant or are planning to become pregnant during training/practice. Samples of survey comments from practicing female vascular surgeons about their experiences (Table I) and their comments regarding implementation of a radiation safety policy (Table II) are included in the article.

DISCUSSION

Radiation effects and recommendations for workers who are exposed to potentially high levels of radiation in procedural rooms have been made by the National Council on Radiation Protection and Measurements. Although these recommendations have been basic to setting national standards for radiation exposures of the public, radiation workers, patients, and the unborn,[10] the implementation of these varies from state to state. All institutions are required to publish radiation safety standard operating procedures concerning pregnant operators. Differences among states are exemplified by an institutional policy in Minnesota, which states that declaration of pregnancy is not required to work with radiation, but if such declaration is done, it must be in writing. In other states or institutions, a confirmatory pregnancy test results or physician letter may be required to accompany the declaration. Institutional or state mandates may dictate the extent of exposure of the pregnant operator. The "radiation policy from an Arizona institution states that holding or manipulating the patient during radiographic or fluoroscopic procedures is not permitted and

Table II. Sample of survey comments from female vascular surgeons regarding implementation of a radiation safety policy

'Women in Vascular Surgery are a reality and this is a huge concern for young women contemplating the field. I think SVS guidelines would establish a baseline.'
'I am 33 years old and I am planning on having a family. I was surprised with the little education about radiation in general (radiation safety) we receive during training without even mentioning pregnancy. Now I am starting my practice and still don't know what to do during pregnancy. There are very few guidelines, if any, published about the topic'
'I think that far too little teaching about personal safety is provided during training and in practice. Watching a 10-year-old VHS tape about radiation safety was all I had to do to get a certificate in my state. It was inadequate. Practical up-to-date information and tips from experts should be included not only in training programs but in SVS-sponsored educational programs and meetings'
'This topic was a major concern of mine when deciding whether or not to do a vascular fellowship. I receive a lot of questions from students and residents on this subject. A policy accepted by the SVS would definitely be helpful.'
'I suspect that most women that want to be a vascular surgeon and want to have a family will figure out how to do it. However, being sensitive to these concerns may help recruit a few more women into the field. Policies and required guidelines for trainees for women only may hinder instead of help the issue. Programs may not want to deal with trying to meet requirements and choose male over female applicants. Perhaps not separating out the women and having safety requirements for all trainees would better address it'
'What I know now is that as long as you practice and comply with radiation safety guidelines, the fetal risk is minimal. Women who are pregnant do not have to do anything special. We can keep working just fine until the time of delivery'
'Radiation safety should be advocated for all. For most women, doing many of the things suggested, like wearing a fetal badge, etc. requires women to reveal pregnancy earlier than most women would like to do so. Is there good evidence based medicine on radiation? My understanding is that most data is derived data from Hiroshima and Chernobyl'
'This is a topic that sorely needs to be addressed as all of our types of training programs take place during childbearing years. Our current integrated vascular residents, men included, are concerned about radiation received even with our monitoring policies in place and the women feel especially vulnerable'
'I think this would help recruit women into vascular surgery'

SVS, Society for Vascular Surgery.

that declared pregnant individuals are not to approach 2 feet of the primary beam during diagnostic fluoroscopic procedures. This may prohibit a declared pregnant individual from working in interventional radiology, cardiac catheterization laboratory, gastroenterology endoscopy, or operating a C-arm in surgery."[11]

Recently, Chambers et al have reviewed this topic and have described a variety of ways to better protect workers and patients.[12] They advocate general education of workers regarding the dangers of radiation. All persons exposed to radiation should use safe radiation safety practices since the prenatal phase (0-8 days before implantation) is the most sensitive phase,[13,14] and organogenesis occurs primarily during the first trimester, when the worker would likely be unaware of the state of pregnancy. Our focus is on physician trainees and practicing surgeons. Since the expansion of the endovascular frontier in vascular surgery, several authors have made recommendations about standard practices in radiation safety and their implementation in endovascular aneurysm repair,[15] and more recently, a review of radiation exposure and endovascular procedures[16] have brought to light the importance of careful patient selection and the education of interventionalists who can take precautions to reduce exposure. A minimization of radiation exposure to the patient and staff can be accomplished in a variety of ways.[17] This is even more important for trainees who have less experience with these maneuvers to reduce exposure. Furthermore, the expansion of the use of stent grafts in repair of thoracoabdomnal aneurysms has resulted in increased radiation exposure, and Panuccio et al[18] have compared indirect versus direct radiation dose estimates in an effort to obtain a more accurate assessment of the amount of radiation exposure given to patients undergoing complex endovascular aortic repair.

The consideration of guidelines for pregnant trainees during radiation exposure is not a new concept. In 2006, Blake et al, in conjunction with the American Association for Women Radiologists and the Association of Program Directors in Radiology, expressed[9] their concern that a minority of radiology residency programs had written policies addressing pregnancy during training. With the support of their program directors, program guidelines were developed for pregnant radiology residents to aid radiology residents and program directors alike. These guidelines gave a rationale for the following: background for radiation exposure and risk, recommendations for safety and regulations, and recommendations that outlined program responsibilities. The salient points of their recommendations to program directors addressed the fact that all residents have the right to a safe and supportive environment, while "providing optimal equipment for radiation safety and monitoring, including image-intensifier lead shielding, maternity lead aprons, dosimetry, and monitoring. General fluoroscopy need not be restricted unless allowable levels are exceeded. Dose rates for fluoroscopic vascular/interventional rotations are highly variable. Therefore, vascular/interventional rotations, usually comprising 3-4 months of the entire residency, should be postponed or completed beforehand."[9]

The objective of our study was to collect opinions from female trainees and surgeons as well as the program directors to create guidelines that are applicable to vascular surgery trainees, helpful to program directors, and readily adapted to practicing female surgeons who are pregnant or may become pregnant. Ideally, this would serve as a springboard for developing policy at a national level in the Society for Vascular Surgery. This has a broader application and is

in response to concerns from the growing female population who is entering or practicing vascular surgery.

This topic was originally presented at the APDVS meeting in 2010, and a majority of program directors expressed their support in participating in this type of survey. This was conducted subsequently with participation of members from the Women in Vascular Surgery group and Program Directors in Vascular Surgery.

One-third of the program directors responded, and, of those, only a minority was aware that there was a written policy or set of guidelines for pregnant residents and fellows exposed to radiation. Less than half acknowledged guidelines in the institution that were applicable to others. The concern regarding radiation exposure has been communicated to some program directors, with some aware that counseling by a physicist regarding radiation exposure to the fetus was available at the institution. Although additional means of radiation reduction and monitoring are noted as being available in a majority of cases, this is something that should be readily available in every institution for a trainee who works with radiation. The Department of Health has released recommendations[19] regarding the dose equivalent to an embryo/fetus, but there is variation in policy from state to state and among institutions. This can be confusing. Formation of guidelines for radiation safety by program directors and leaders of the vascular society should be commonplace among trainees and faculty who work with radiation in vascular surgery. These guidelines would potentially alleviate concerns of trainees and provide a transparent plan for all. This would help establish standards that improve radiation safety for trainees and surgeons in general. The lack of pregnancy lead or availability of fetal badges can be readily addressed with the institution as a recommendation from our society leaders for the common good. Information regarding radiation safety in general and, in particular for pregnant vascular surgeons who work with radiation, should be easily obtainable. While the information may be available in the institution, access to it is often difficult and unclear. Only one-quarter of the program directors reported having allowed restrictions on fluoroscopy exposure for pregnant trainees, and three-fourths would allow flexibility in the rotation or on-call schedule for a pregnant trainee. Some consensus regarding options for the pregnant female to adjust her rotation schedule to minimize radiation exposure during more critical periods of the pregnancy would also provide a plan to balance the training and not put increased strain on the other residents. It is important to recognize that this affects the surgical staff and other trainees in the program.

Our recent publication in the January 2011 supplement of the *Journal of Vascular Surgery* regarding radiation safety looked at radiation exposure and pregnancy and reviewed the literature to date. The dose effects on the fetus were described, and the differential effects of radiation on the fetus based on the stage of pregnancy were also discussed.[11] Education regarding the biological effects of radiation should be readily available.[20] These biological effects on the pregnant operator not only have the potential to injure the operator, but also the fetus and future germ cell lines as well. The availability of pregnancy lead and also consideration that trainees and surgeons should have their own personal lead and not use community lead is a reasonable expectation and reflects concerns expressed in responses to this survey that community lead is often improperly handled and may be cracked and less protective. This lead is screened once a year and allows a substantial window of time during which that lead may not be adequate to protect the operator or the fetus. The placement of the radiation badges and careful monitoring of these badges, especially during the pregnancy, should be emphasized. Badges should not be left on the lead as others may use that lead and result in an erroneous dose level attributed to the pregnant operator.

Taking these things into consideration, some appropriate recommendations can be made to address the concerns of pregnant female trainees and surgeons as referenced in our paper regarding radiation safety and pregnancy.[11]

The pregnant operator should be aware that careful planning, understanding of the risks, and minimization of radiation dose can permit pregnant operators, in most cases, to safely perform procedures without the risk of fetal injury or death. Use of an additional monitoring device, the fetal badge, is to assure that the maximum radiation dose to the fetus of 500 mrem over the entire gestational period is not reached. Every effort to reduce exposure should be taken by the pregnant operator. This includes minimizing fluoroscopy time, careful planning to reduce unnecessary imaging or using ultrasound guidance when possible, stepping up to 6 feet away from the table, if possible, during imaging runs, or using movable lead shields placed between the X-ray beam and the operator. In addition, collimation of the radiographic beam may reduce the peripheral portion that reaches the operator. The principle of "as low as reasonably achievable" should be followed. Moreover, the degree of apron protection is important, and the operator may consider additional coverage, such as wearing wrap-around aprons or "maternity" lead.[11]

This survey also revealed that more than three-fourths of the program directors that responded to the survey would support development of a national policy, and a larger majority would incorporate them into their program. The majority of faculty surveyed had been in practice 1 to 15 years, with over half having been pregnant during training or in practice. It is notable that there is discordance between the number of pregnant females doing endovascular procedures and those who were given a fetal badge for additional monitoring. Less than half had any counseling about radiation protection during the pregnancy. Although a majority felt supported and treated fairly, there was a significant number that did not feel this way. About half felt that accommodations were made for the pregnancy that would allow performance to the best of one's ability without undue stress on the fetus. These numbers reflect that there are a number of programs that may benefit from guidelines to try to improve upon these issues. The women could feel more supported, allowing for more transparency

Table III. Suggested program guidelines for vascular surgery trainees

1. Vascular Surgery training programs are expected to create a safe and supportive environment for all residents and fellows, which includes providing optimal equipment for radiation safety and monitoring, (i.e. image-intensifier lead shielding, maternity lead aprons, dosimetry, and monitoring).[9]
2. Dose rates for endovascular rotations are highly variable. Therefore, safety guidelines regarding the amount of radiation permissible during pregnancy and options for fair redistribution of duties and rotations during pregnancy need to be clearly delineated.
3. Regarding a clear definition of occupational radiation dose limits during the 9 months of pregnancy, most state guidelines agree that 500 mrem during the entire pregnancy or 50 mrem/mon is a safe dose. This translates to 100 to 1000 fluoroscopic examinations of 5 minutes each per gestational month.
4. Strict measures to decrease exposure during fluoroscopic procedure/exam include:
   - Availability of maternity aprons to pregnant residents (1.00-mm lead equivalent with double-lead inserts over the pelvis), which decrease dose by a factor of nearly 100 compared to standard aprons);
   - Encouragement of low magnification use during the procedures and collimation; and
   - Strict dosimetry and monitoring using a fetal monitoring badge and a badge under lead in accordance with as low as reasonably achievable principles.
5. Delineation of resident role when pregnant and redistribution of responsibilities: pregnant residents should be reassigned to rotations not exposed to significant radiation at least for the crucial gestational weeks.
6. Pregnant residents should be expected to participate fully in the residency; however, adjustments in rotation schedule should be possible with an effort made to not detract from their experience or that of their co-residents.[11]

in regards to the expectations of a woman who becomes pregnant and how this will affect her training or practice.

Comments (see Tables I and II) from responders to the survey suggested that some women felt that there was little information available describing proper protection and risks for pregnant vascular surgeons. Some had concern that residents are getting more radiation exposure than faculty since they are using older potentially damaged community lead.

Others noted that they felt like their program director was unsure how to handle the pregnancy. This has led to uncertainty about performance and expectations. Since the guidelines are lacking, there are vastly different experiences among the trainees surveyed. The guidelines would help to create a general standard, and trainees and female surgeons would feel less singled out, less marginalized, and more at ease. There was some concern raised that the creation of standard guidelines may actually cause program directors to avoid hiring women; however, with the growing pool of talented female applicants, this is unlikely to be the case, as the best applicant is usually chosen. Ultimately, with proper education and preventive measures, including pregnancy lead and fetal monitoring, and some flexibility on the part of the program directors, with modification of rotation schedules or on-call schedules, the risks can be minimized, a more optimal training can be had for pregnant trainees, and a disproportionate burden on other trainees in that program can be avoided (Table III). These guidelines can then be extrapolated to pregnant surgeons exposed to radiation in practice with optimization of safety measures, better understanding of risks, and availability of information. As general guidelines do exist on the state level, review of these and the addition of guidelines that are pertinent to the needs of our specialty are what would benefit female medical students, trainees, and practicing female surgeons who plan to become or are pregnant. The survey revealed a varied level of knowledge and understanding of the risks and measures to be taken among the responders. Education at the society level through online radiation safety education modules and postgraduate courses or examination questions on the written board examination can improve upon this and emphasize safety measures.

CONCLUSIONS

There is compelling interest to establish radiation safety guidelines for the pregnant trainee or vascular surgeon. Consideration should be given at the Society leadership level to develop and support radiation safety guidelines for all vascular surgeons.

AUTHOR CONTRIBUTIONS

Conception and design: PS, AR, AV
Analysis and interpretation: PS, AR
Data collection: PS, AR
Writing the article: PS, AR, AV
Critical revision of the article: PS, AR
Final approval of the article: PS, AR, AV
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Additional material for this article may be found online at www.jvascsurg.org.

Appendix I (online only). Survey 1

Survey of Association of Program Directors in Vascular Surgery

1. Does your program currently have a written policy, a set of guidelines or offer other special accommodations, for pregnant residents or fellows (eg, scheduling, rotations) exposed to radiation? _9_ YES _17_ NO _6_ UNSURE
2. Does your institution and/or department have a written policy applicable to other pregnant radiation workers (faculty radiologists, vascular surgeons, technologists, etc.)? _13_ YES _7_ NO _12_ UNSURE
3. Have pregnant residents/fellows expressed concerns to you over radiation exposure? _9_ YES _10_ NO _0_ UNSURE _13_ NA
4. Can pregnant Vascular Surgery trainees receive counseling regarding radiation exposure to the fetus from a medical physicist and/or faculty member at your institution? _23_ YES _0_ NO _3_ UNSURE _6_ NA
5. Are limits or restrictions placed on fluoroscopy and/or interventional work for pregnant Vascular Surgery trainees? _8_ YES _8_ NO _7_ UNSURE _9_ NA
6. Do the pregnant trainees or other personnel at your institution have access to any additional means of radiation reduction (eg, double-lead aprons, pregnancy lead)? _23_ YES _1_ NO _2_ UNSURE _6_ NA
7. Do the pregnant trainees or other personnel at your institution have access to any additional means of monitoring (extra dosimeter badges or fetal badge)? _22_ YES _0_ NO _4_ UNSURE _6_ NA
8. Would you allow a pregnant trainee to change her rotation schedule to minimize radiation exposure? _24_ YES _1_ NO _1_ UNSURE _6_ NA
9. Do you support development of a national "standard" policy – or set of guidelines – regarding pregnancy during vascular surgery residency/fellowship? _24_ YES _4_ NO _4_ UNSURE
10. Would you incorporate into your program, either in part or in whole, such a national "standard" policy or set of guidelines? _26_ YES _22_ NO _4_ UNSURE

Appendix II (online only). Survey 2

Survey of Women in Vascular Surgery: 53 responders

1. Choose your practice setting
   Academic practice __28_
   Private Practice/Teaching Program _5_
   Private Practice/ No Resident or Fellow interaction _9_
   Currently in a Vascular Surgery Fellowship/ Residency _8_
   Other _3_
2. How long have you practiced?
   Currently in a vascular surgery fellowship/residency _9_
   <1-year _2_
   1 to 5 years _20_
   5 to 15 years _14_
   15 to 30 years _8_
   More than 30 years _0_
3. Were you pregnant during your vascular training? _28_ YES _25_ NO

Response to questions related to those women who were pregnant during their training.

27 Responders

1. Did you perform endovascular procedures during the pregnancy? _13_ YES _2_ NO _4_ Don't know/no answer
2. Did you feel supported by your institution during the pregnancy to monitor your fluoroscopic exposure (ie, counseling by a physicist)? _8_ YES _6_ NO _4_ Don't know/no answer
3. Did you wear a fetal badge (an extra badge at waistline under lead)? _8_ YES _7_ NO _4_ Don't know/no answer
4. Were there any complications during the pregnancy that caused you to alter your daily routine as an endovascular specialist (ie, stop doing those procedures or limit call)? _1_ YES _14_ NO _4_ Don't know/no answer
5. Did your program support you? _12_ YES _2_ NO _5_ don't know/no answer
6. Did you feel you were treated fairly during the pregnancy? _13_ YES _1_ NO _5_ don't know/no answer
7. Were accommodations made to allow you to perform to the best of your ability without putting excessive stress on the pregnancy/fetus? _10_ YES _5_ NO _4_ Don't know/no answer

Please answer the following questions related to your experience as a pregnant vascular surgeon. 28 Responders.

1. Have you been pregnant while in practice? _23_ YES _5_ NO _0_ don't know/no answer
2. Did you perform endovascular procedures during the pregnancy? _22_ YES _2_ NO _3_ don't know/no answer
3. Did you feel supported by your institution during the pregnancy to monitor your fluoroscopic exposure (ie, counseling by a physicist)? _14_ YES _9_ NO _4_ Don't know/no answer
4. Did you wear a fetal badge (an extra badge at waistline under lead)? _13_ YES _9_ NO _4_ Don't know/no answer
5. Were there any complications during the pregnancy that caused you to alter your daily routine as an endovascular specialist (ie, stop doing those procedures or limit call)? _4_ YES _20_ NO _3_ Don't know/no answer
6. Did your program support you? _18_ YES _5_ NO _4_ don't know/no answer
7. Did you feel you were treated fairly during the pregnancy? _20_ YES _3_ NO _3_ don't know/no answer
8. Were accommodations made to allow you to perform to the best of your ability without putting excessive stress on the pregnancy/fetus? _11_ YES _10_ NO _6_ Don't know/no answer

Whether or not you were yourself pregnant during training or practice, please answer the following questions: 53 Responders

1. Do you feel that established guidelines for pregnant trainees/attendings in Vascular Surgery would be helpful? _48_ YES _4_ NO _1_ Don't know/No answer
2. Do you feel that establishment of a transparent policy for radiation safety during pregnancy for trainees would aid in the recruitment of talented women into the field? _41_ YES _11_ NO _1_ Don't know/No answer
3. Do you feel that a policy accepted and supported by the leadership of the Society of Vascular Surgery would be helpful and encouraging to those women planning to or who are pregnant during training or entering Vascular Surgery practice? _48_ YES _2_ NO _3_ Don't know/No answer